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journals where it is fully described, and all improvements to date. If it was desired to produce a low vacuum, all the known methods and the limitations of each would be at once found in such an encyclopedia. If one wished to measure low pressures, the encyclopedia would call his attention, with references, not only to the McLeod gauge but also to the recently devised molecular gauge which might give more accurate results in those particular measurements. If one wished to maintain a constant temperature at several successive points from the temperature of solid carbonic acid to that of liquid air, he might spend a long time in devising an apparatus, but the encyclopedia would at once refer him to the methods that have been successfully employed. Such a publication would add much to efficiency, and the cost would be small compared to the great service rendered to science.

We also need a *journal of scientific instruments*, in English, devoted entirely to the description of new methods and instruments.

I have often felt the need of both such publications, and I am sure that much energy now wasted would be conserved, and on the whole more worthy contributions to science produced. When once accustomed to such necessities we should wonder how we managed to do without them.

We are entrusted with the responsibility of solving some of the greatest and grandest problems confronting the race. It is our plain duty to be improving conditions for individual and general efficiency. We must point out the needs of science in definite and concrete terms, and must not hesitate to urge upon society that it supply all real physical needs for the proper prosecution of its scientific work.

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PSYCHOLOGICAL AND HISTORICAL INTERPRETATIONS FOR CULTURE¹

THE mere fact that we have in Section H a joint segregation of anthropology and psychology would seem to imply some close functional relation between these sciences. However, the most probable explanation of the phenomenon is to be found in the distinctly anthropological conception of historical association. If one may be pardoned the diversion, I would say that most likely this association is due to the shrewdness of some one in finding a chance to smuggle psychology into the scientific camp. Yet, if one recalls the various annual programs of the section, there comes to mind a considerable number of papers and addresses professing to authoritatively interpret cultural phenomena by the aid of psychological conceptions. So far as I know, the authors of these papers have all been psychologists, rarely has an anthropologist ventured to set the psychologists right. Many of these psychological discussions of anthropological problems have struck the anthropologists as a bit naïve and I have not the least doubt but that for once, the psychologists will in turn get a naïve reaction, because I propose to present reasons for doubting the validity of such psychological explanations for cultural phenomena.

We have a considerable bibliography under the heads of psychology of religion, psychology of art, psychology of sex, and psychology of society. Of these the professional psychologists have the first two almost entirely to themselves, but share the others with the sociologists. In the development of their subjects, the psychologists

¹ Address of the vice-president and chairman of Section H, Anthropology and Psychology, American Association for the Advancement of Science, Columbus meeting, December, 1915.

have as their fundamental assumption the belief that religious phenomena are susceptible to statement in psychological terms and that their ultimate explanation is to be sought in conventional psychological principles. By analysis, they seem to seek for a psychological mechanism, or a fixed association of activities, that is responsible for the appearance of religion on the earth and its subsequent development. One of their initial assumptions is that by this mechanism, or whatsoever they prefer to call it, man has gradually built up the religion of the world to-day. They take for granted that the religions of the less civilized peoples of our time are examples of the earlier forms of this development, and seek in them the fundamentals of religious evolution. The chief aim is to show how the religious activities of our people can be explained as normally evolved from the functioning of this assumed mechanism. It follows that one of these psychological authors would consider his task brought to a glorious end if he could formulate a statement of the gradual building up of religion that was entirely consistent with the data at hand; and would consider that he had revealed the cause of its appearance to lie in a definite mode of action in man's nervous system.

Though we have so far spoken in terms of religion, the general assumptions in the treatment of art, sex, etc., appear to be the same. All these psychological investigators are striving to bring the phenomena of culture entirely within the conventional limits of psychology and to explain it by psychological principles.

In order to bring out clearly the differences between this attitude and that now assumed by our representative anthropologists, we may try to apply the same mode of characterization to their works. I do not recall any serious recent attempt on the

part of an anthropologist to discuss the anthropology of religion as a whole or to examine our own religion by anthropological tools, but if the attempt were to be made, the preconceptions would be about as follows. In a treatise on our religion, the phenomenon would be considered adequately explained by identifying it with culture. Culture origins would be sought in a comparative analysis of our religion and in tracing out the sources from which the various elements in the complex came. The ideal would be to state where, among whom and under what conditions, these several elements arose and were associated in the present complex, the whole constituting what may be considered as a historical explanation. It is not conceived that the carrying of this analysis to its ultimate extreme would give us a statement of religion as a world phenomenon, for the religions of other peoples have different histories, and though we see on every hand indisputable evidences of mutual borrowing and interaction, the fundamental elements of the world's religions have decided individuality. Hence, if we confined our efforts to tracing out the historical development of only such elements as are found in our own religion, we should ignore a considerable part of the phenomenon at large. Therefore, a general treatise on the anthropology of religion would begin with the exhaustive study of a number of religions and finally seek by a comparative view, a generalized statement of the historical relations between the religions of the world. Thus could be constructed a theoretical outline of the development of religion as we now find it among the several peoples of the earth. On practically the same lines we should expect to develop the anthropology of art, literature, music, marriage, social organization, etc.

Now if these are true characterizations

of the two methods, it is clear they have important differences. Both use the same data as to the kinds of religious activities in the world, but the psychologists seek their origin in universal psychic activities, while the anthropologist is content to find the approximate localities and relative times whence the various elements come into view. Though perhaps not at first apparent there is nevertheless a fundamental difference between the two, which it is my purpose to develop in this discussion.

Like psychology, anthropology has been rapidly developing its problems and conceptions, and is just emerging from its formative period. Its position and scope is perhaps as clearly formulated now as is that of psychology. In the main, it deals with culture and the various problems directly related thereto. Anthropology is perhaps most correctly defined as dealing with the first appearance and subsequent career of man upon the earth. While comparative morphology in all its human aspects is an important method, it is based upon and dependent upon other sciences and has for its ultimate goal the elucidation of historical cultural relationships. Culture is the distinctly human trait and must always be appealed to to determine the status of such fossils as the *Pithecanthropus erectus*.

Cultural phenomena are conceived of as including all the activities of man acquired by learning. Thus we eliminate, on the one hand, the permanent individualities of the separate men and, on the other, whatever equipments they may have had by birth. Cultural phenomena may, therefore, be defined as the acquired activity complexes of human groups.

It follows, then, that there is a problem of almost equal concern to psychologists and anthropologists—the differentiation between the innate and the acquired. Psy-

chologists give their attention to innate phenomena, especially man's psycho-physical equipment. If we extend the meaning of the term behavior so as to include consciousness, we may say that psychologists are concerned with the behavior of man as an individual. If one may trust to the remarks heard, psychologists are quite given to the assumption that anthropologists are simply students of comparative human behavior. At least psychological literature contains more than one example of the behavioristic interpretation of cultural data. Now, it may be that there is a problem in the comparative behavior of the individuals comprising ethnic groups, but, if so, it is a psychological one and must be solved by the use of psychological data. Anthropologists give it little concern because they see in differences of individual behavior no significant cultural correlates. So far as they can see, all the known culture phenomena since the dawn of the paleolithic period necessitate no changes in man's innate equipment nor in his innate behavior. So, on the whole, anthropology is quite indifferent to the problems of comparative behavior, because it is concerned with the objective aspects of what is learned in life.

There is, however, one problem that troubles the anthropologists, viz., to distinguish between the innate and the acquired elements of the more fundamental activity complexes. One of the pressing anthropological problems of the hour is the effectiveness or non-effectiveness of instinctive factors in the differentiation of cultures. The problem is almost identical with the educational problem of inborn *versus* learned activities. The only systematic discussion of this problem is Thorndike's "Original Nature of Man," which, while projected from an educational horizon, is, nevertheless, a distinct contribution to the anthropological problem. One of

this author's illustrations may be cited as an example of the anthropological problem: thus we are told "that a child instinctively conveys food to his mouth with the naked hand, but by habit comes to use a spoon" (p. 3). Here it is clear that the use of the spoon in eating is a cultural fact in contrast to the use of the hand. As such, it falls into the same class with forks, saws, rifles, automobiles, etc., or into the general class of tools. A little reflection or a visit to an anthropological museum will show how completely tools dominate the objective phenomena of culture. Yet, our problem is far from simple. For example, what shall be said when the baby grasps the spoon and pounds upon the table with every manifestation of joy? Is pounding a phenomenon of culture or is it a part of original nature? The anthropologist very much needs to know where the distinction falls. He has at various times given it serious consideration, but finds no way to approach it save by logical analysis, resulting in the formation of an opinion. It seems that psychologists have done no better. Thorndike, for example, is delightfully frank in stating that in most cases as yet he is able to do little more than formulate an opinion. His general statement seems to be that while original nature often decides that an individual will respond to certain situations, it far less often imposes upon him a definite response or limits the time of such response. To this, as a generality, anthropologists will agree: it is in fact another way of stating their own opinions. To them its formulation would be something like this: while all culture is acquired, there must still be a complex of instincts to acquire and participate in cultural activities; but only very rarely, if at all, specific instincts for the acquisition of a particular culture. While such generalities are of great value, serving to clear the

air as it were, they unfortunately solve no problems nor relieve us of the necessity for real concrete investigation.

Reverting again to the tool-using complex, the anthropologist is quite ready to assume that to seize any convenient object and use it to assist movement is instinctive; and more, that the tendency to observe the specific use of tools by others and self-learn the use of the same, is in its fundamental aspects instinctive. Finally, there is a presumption that there is some instinctive factor in the invention complex, that leads to the production or modification of culture traits. That there must underlie the development of cultures an instinctive complex tending to culture production seems a necessary assumption to those familiar with anthropological data.

One general point about which psychologists seem to agree is that the associations of ideas are not innate. This is expressed by Thorndike (24) as follows:

It is unlikely that the original [innate] connections are ever between an *idea* and either another idea or a movement. No one has, I think, found satisfactory evidence that, apart from training, an idea leads of inner necessity to any one response. And there is good evidence to show that original connections are exclusively with sensory situations. . . . We have, of course, by original nature the capacities to connect the idea of one thing to the idea of another thing when the two have been in certain relations, and to break up the idea of a total fact into ideas of its elements, when once ideas have been given that are capable of such association and analysis. But we do not apparently, by original nature, have preformed bonds leading from ideas to anything. If an idea apart from training provokes a response, it does so by virtue of its likeness to some sensory perception or emotion. Nor do we apparently by original nature respond to a situation by any one idea rather than another. *That* we think is due to original capacity to associate and analyze, but *what* we think is due to the environmental conditions under which these capacities work.

The *what* we think is largely determined

by our culture, for, so far as anthropologists can see, a culture is a definite association complex of ideas. When anthropologists assert that culture is not innate, they have this in mind and should, if it were true that definite associations between ideas were innate, find it difficult to harmonize these contradictions. The assumption, therefore, that it is chiefly between sensory factors that inborn connections exist, is complementary to the anthropological view. In content, culture is highly rationalistic, or fundamentally a matter of thought, or idea connection. There is, however, considerable confusion on this point, apparently due to lack of discrimination as to the thinking process and what is thought. As we have already noted, the individual's attitude toward culture is apparently entirely an innate affair, or is truly a part of his innate behavior. The obscurity of the case arises in part from the fact that it is this innate behavior that produces cultures and perpetuates them. It is quite natural, therefore, that many should claim the non-rationalistic factors as cultural. We have various fairly satisfactory theories of culture origin based upon the conception that man's less material traits are rationalistic constructs from instinctive actions, the latter serving as the suggestive structural elements. Our contention here is, however, not on the reality of an instinctive basis to culture, but that the investigation of man's true behavior is a psychological problem and must be approached from the psychological horizon. The moment we, as anthropologists, attempt to apply cultural data and cultural methods to these underlying instinctive phenomena, our psychological friends will find our assertions just as naïve as theirs to us when they reverse the application. Since we can not expect to be at home in the psychological field, we must leave those problems to them.

Perhaps in passing we should note the much-discussed question as to the power of ideas, for many psychologists vigorously insist that an idea can in some way lead to action irrespective of other conditions. Now it may be that every idea causes a reaction, as to that an anthropologist's opinions are of no importance, but such acts seem to fall into the behavior class and belong, therefore, to the innate equipment of man for cultural activity.

We are familiar with the fact that all the known cultures of the world have certain marked similarities; in fact, from one point of view, they are very much alike. It has been claimed that this likeness is due to many fundamental ideas in common. Bastian seems to have believed that these ideas were to be found wherever people lived, because the very constitution of their nervous system made them arise with certainty. Now, if this is true, such ideas must be set down as part of man's original nature. If they result as a universal response to situations, the situations must be uniform; but in any event, if all men, however isolated from birth, will get these ideas, then they are essentially inborn and so constitute the basic elements of culture.

We may also note the older belief that man's original nature was so ordered that social groups everywhere tended to develop their culture on the same pattern, rising from the lowest state of savagery to the highest civilization. This again, if true, would necessitate a kind of mechanical view, for we make the whole merely a response on the part of man's original nature.

However, these views are quite antiquated. We now have the rival theories of independent development and single origin of culture traits. In response to the independent versus common origin of traits, we have such compromise theories as convergent evolution, limited possibilities, etc.

The problem confronting these theories is to identify the causes underlying the observed similarities of culture traits.

It is clear that the theory of a single origin for even the most widely distributed traits assumes no necessity for the inheritance of particular ideas. The theory of independent origin when invoked to explain the occurrence of certain traits in large distinct areas as in both the Old and New World, is also consistent with the unoriginal nature view; but when pushed farther and made to account for the separate appearance of a trait in many places, leads its supporters into an embarrassing position. When we assume a single place of origin for a trait, we take the view that its appearance is accidental. Thus, original nature offers no explanation for the event, only a historical account of what transpired in the place and time will suffice. For example, some anthropologists are of the opinion that the bow was invented but once and thence found its way gradually over the world by diffusion. (This seems likely in view of the known history of firearms.) In such cases, it appears that the invention and its development in one place is due to the chance combination of many causes. Underlying it is an idea whose occurrence in the mind of an individual was truly accidental. I have elsewhere referred to this view as the *psychic accident* theory for culture origin. Now the difficulty in extending the independent origin theory to many small areas is that we have too many accidents, unless one can show that the possibilities are limited to a few alternatives and that all men will be made aware of the same kind of situation. However, few anthropologists take the extreme view that all occurrences of the same trait are due to independent invention, the general tendency being, when a trait has a continuous distribution over an area, to

consider it as having been diffused from one point or center included in, or contiguous to, the area in which it is found. Thus, that the bow may have been invented in two or three parts of the world is conceivable without doing violence to our experience with chance phenomena; but, if we go on and divide up the world into small units we soon reach a point where we must find other than accidental causes. The defenders of the independent theory recognize this, for practically all resort to the assumed unity of the human mind to account for the frequency of widely distributed traits; but when they do so they put themselves into a position where the denial of direct dependence upon original nature is next to the impossible.

In general, if we take cognizance of psychological knowledge, it appears that so far all attempts to explain particular culture traits as due to the unity of the human mind have been abortive. On the one hand, we have no psychological evidence that particular ideas are due to particular psycho-physical biases—in fact there is abundant evidence to the contrary—while on the other, we have the obvious fact that cultures do differ and that one of these common culture traits when displaced soon passes into oblivion or does not recur. For example, how many of us would ever have conceived a bow, if the thing were not taught us? Further, the unity of the mind theory ignores the great unity of the physical world which certainly controls many traits of culture. Thus, the problem of cutting has but one ready solution, a material harder than that to be cut and a knife edge. This is due to the physical unity of the world. Hence, whenever men happen to solve this problem, their solutions tend to similarity in the essentials of cutting tools; but if the unity of man's mind predetermined the solution, why should we

have such a variety of cutting tools as we find in our museums? The unity of mind seems to be an expression for uniform behavior and applies to the original nature of man. To explain facts of culture by asserting the unity of the human species, is little more than the useless pleasantry that culture exists only because there are men in the world. But one may retort that a psychology of religion, or what not, seeks to discover precisely why these ideas arose or were so associated. Our contention is that this can be done only by knowing the history of the case and that this history can not be reconstructed from an ensemble of culture traits, however minutely they may be described in psychological terms.

In the various aspects of the tool traits of culture we have one of the most important series of data bearing upon both the psychological and the anthropological problems of culture origin. It is perhaps less fundamental than language, but is objectively superior because of the indestructible nature of many types of tools. For example, we find in the cave deposits of western Europe, some of man's first stone tools. We have previously noted the probably instinctive basis for tools. Thus, it may be granted that man is by original nature a tool-using and tool-wanting animal. Yet it is difficult to determine if he is a tool-maker by original nature, for the tool-making complex appears as only the mechanical adaptation of natural forms in which materials are found. It has been shown by anthropologists that many forms of stone tools are but slight modifications of selected pebbles, whose natural shapes were adapted to the specific purpose for which tools were sought. The same general principle holds for all tools, for the maker has to adapt his methods to the mechanical properties of the original materials from which the tools were to be made. This adaptation is surely

the rationalization of experiences arising from original responses to tool-using situations. This invention, or the production of new traits of culture, may itself be rationalized, as is the case when we deliberately set ourselves an inventive task, or even when we recognize the inventive process as a method of culture production. All this must be granted, but there are innumerable times when new conceptions come as the normal undirected activity of thought. So it seems that rationalization must as a process be original or a part of man's original nature. We see that culture production, as the devising of tools, etc., is a product of the rationalizing capacity of man, which in turn is a part of his original nature. Therefore, there is good reason for assuming an underlying innate basis for tool-making in particular and culture production in general.

This clears the way to a fundamental problem: viz., the origin of culture. If culture is a matter of ideas, or the functioning of the rationalizing mechanism, then the first prerequisite to the observed condition is the appearance of an anthropoid with this element in his original nature. The forms and varieties of cultural remains seem to necessitate from the first the existence of this rationalizing power at its present level. Thus, it may be objected that the forms of stone tools found in the oldest cave deposits were produced by instinct alone, just as the spider spins a web or the bee fashions a comb. The answer to this lies in our museum collections where we find considerable variety in form in a given deposit, but particularly in the many sudden and abrupt changes as we pass from one stratum to another. Then again, Australian natives were but recently observed making forms identical with some of paleolithic origin and with them the instinctive explanation would be absurd. Their

method of learning the art and their mechanical attitude toward it is as rationalistic as similar homely arts are with us. In brief, we fail to discover any essential differences in the tools of early man and those now made in a rationalistic manner; hence we can do no more than assume that from the first they were mere inventions. There may be, however, very great differences in the intensity of rationalization between our ancestors and ourselves, but it is difficult to see how even the earlier cultures we know could have taken form without the same qualitative rationalizing power. Further, one of the questions anthropologists would like to hear discussed is as to whether the assumed greater intensity of modern rationalization is not merely apparent, only the accumulated momentum or the complex of short-cuts our culture has developed. Anthropologically, it seems that the phenomenon is entirely one of accumulation and short-cuts; but this may be found incompatible with psychological and biological data.

Returning now to the question of a tool-using instinct as previously stated, it may be objected that this also is but a rationalization or invention, and so not innate. Now at least grasping in the hand is innate and so is the picking up of objects. Then since there is certainly an innate striking response, we have at least the necessary elements of instinctive activity. Though we are here dealing with a problem yet to be solved, my own observation seems to justify the assumption that to seize an object and pound with it rather than the hand, is an innate phenomenon even in very young children. As suggested above, anthropologists favor the view that no mechanical movement complexes for tool-making are innate, but that there is in man's original nature a mechanism that lays hold of things and thus supplies the basis for self-

rationalization and for the acquisition of the great store of accumulated rationalizations of the race, or culture.

The point we are coming to is that the anthropological conception of culture is entirely consistent with the psychological view, for it asserts that neither mental bias nor biological attributes are of the least avail in explaining the origin of specific culture traits and that it is only when we know the history of a case that we can give anything like an adequate account of its origin. It is thus clear that when we are dealing with phenomena that belong to original nature we are quite right in using psychological and biological methods; but the moment we step over into culture phenomena we must recognize its historical nature. This is why anthropologists object to much that passes for the psychology of religion, art, etc., in which many of the results obtained by use of the historical method are put on a level with those obtained by other methods, and then interpreted as facts of evolutionary or other non-learned activities. To them such terms as psychology of religion, psychology of society, of law, of sexual restrictions, etc., are often so used as to be worse than meaningless for they at once assert what is contradictory to psychology itself.

We are now ready to consider the value of psychological explanations for culture origins. We often read that if culture phenomena can be reduced to terms of association of ideas, motor elements, etc., there remains but to apply psychological principles to it to reveal its causes. This is a vain hope. All the knowledge of the mechanism of association in the world will not tell us why any particular association is made by a particular individual, will not explain the invention of the bow, the origin of exogamy, or of any other trait of culture except in terms that are equally applicable

to all. What more can psychology tell us than that these inventions were thought out by somebody. So when a culture complex has been analyzed and found to rest upon the association of two or more ideas, we do not thereby raise a specific psychological problem at all. The problem we do raise is as to where and at what relative points in man's career did these ideas appear, and the solution is to be sought in the historical relations of the people among whom they originated and not in innate psychological characters.

Our purpose is not to deny the existence of a psychological problem in culture; far from it. We are only pointing out what aspects of the problem can consistently be subjected to psychological methods and calling formal attention to the very crude method of taking learned activities for innate ones and thereby explaining cultural phenomena. Psychology can be of the very greatest service to anthropology by discovering the relations between man's innate and cultural equipments.

CLARK WISSLER

THE AMERICAN MUSEUM
OF NATURAL HISTORY

CHARLES RENÉ ZEILLER

LORRAINE has produced many men who have adorned the annals of the sciences, arts and politics of France. None are more worthy of honor than Professor Zeiller, the dean of paleobotanists, who passed away at his home in Paris on November 27.

Born at Nancy on January 14, 1847, he was educated at the École Polytechnique and École des Mines, so that naturally he was a member of the auxiliary corps of engineers during the Franco-Prussian war. His father was engineer-in-chief of bridges and highways of Lorraine and on the maternal side he was descended from the sculptor Guibal.

Although the illustrious mantle of Brongniart and Saporta has long rested on Zeiller's

shoulders his earliest contributions were not paleobotanical, but metallurgical and geological, and published in the *Annales des Mines* in 1870 and again in 1871, both devoted to the Eifel region. In 1873 he published a memoir on the eruptive rocks and metalliferous veins of the Schemnitz district. His first paleobotanical contribution was an analysis of Schimper's great work, "Traité de Paléontologie végétale" and published in the *Revue scientifique* in the spring of 1874, thus indicating the trend of Zeiller's mind at that time and foreshadowing the field of endeavor to which he was to so successfully devote the mature years of a reasonably long but never robust life.

As an engineer of mines the fossil floras associated with the coal were the subject of his chief professional interest, although Zeiller was not a narrow specialist, but a contributor to all phases of paleobotanical activity. With a rare facility he was equally effective in describing the histology of *Sphenophyllum* and *Lepidostrobus* or the impressions of plants of the Paleozoic, Mesozoic or Cenozoic. The last paper from his hand that I have received was an account of the Wealden flora of Peru, and in his last letter, written just before the end, he asked me to send him a copy of Walcott's recent paper on Algonkian Algæ. It was this world-wide interest combined with a philosophical temperament that made the many annual reviews of the progress of paleobotany published in the *Annuaire universel de Géologie* and the *Revue bibliographique* of such lasting value.

Zeiller's first original contribution to paleobotany was an account of the flora of Ternera in Chili published in 1875, and the wide interest and facility of treatment are shown in a succession of works whose stratigraphic range is from the Devonian of Pas-de-Calais to the Tertiary of Tonkin-China, embracing discussions of floras of the Carboniferous, Permian, Triassic, Jurassic, Cretaceous and Tertiary. Outside his native land he contributed to the paleobotany of Spain, India, the Vosges, the Balkans, New Caledonia, Indo-China, Madagascar, Central and South Africa,